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PCT/JP01/01810, filed March 8, 2001, claiming a priority date of March 8, 2000, and published in a non-English language.

Please replace the paragraph beginning at page 1, line 3, with the following rewritten paragraph:

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The present invention relates to an image reading apparatus in which a synthesized whole image is obtained from partial images through detection of a relative moving amount of the object of reading and the image reading apparatus, whereby it is possible to read an object having protrusions and recesses like a fingerprint and a planar object having light and shade portions like an original document.

Please replace the paragraph beginning at page 1, line 15, with the following rewritten paragraph:

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The image reading apparatus for reading fingerprints shown in Fig. 18 utilizes differences in reflected light due to the differences in state of contact between the crests and troughs of a fingerprint when the tip of a finger is applied to an optical member having a transparent input surface like a glass plate. That is, when a finger 107 is applied to an input surface of a prism array 101 consisting of glass, synthetic resin or the like and serving as an input member, the crests of the skin are in contact with

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the input surface of the prism array, whereas the troughs of the skin are in contact with air. Thus, when the incidence angle becomes close to the critical angle at the interface between the prism array and the air, the reflectance becomes relatively high in the troughs, with the result that there is generated a large difference in reflectance between the crests and troughs, and the crests and troughs of the fingerprint are read as a light-dark pattern.

Please replace the paragraph beginning at page 2, line 11, with the following rewritten paragraph:

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--Further, an example of an image reading apparatus having a light detecting means and adapted to read fingerprints and original documents by synthesizing a two-dimensional whole image from partial images through relative movement of the object being read and the image reading apparatus is disclosed in Japanese Patent Application Laid-Open No. 10-240906, according to which illumination light is caused to impinge vertically upon the input surface to detect vertical reflected light.

Please replace the paragraph beginning at page 4, line 4, with the following rewritten paragraph:

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--To achieve the above object, there is provided in accordance with the present invention an image reading apparatus comprising a light source, an input member having an

input surface for reading an object, and a light detecting means composed of a plurality of photoelectric conversion elements for detecting light scattered or reflected at an interface between the object and the input surface,

CS wherein the input member consists of a transparent base member and is formed by a rotary member rotating in accordance with an amount of relative movement between the object and the image reading apparatus,

the apparatus further comprising a whole image synthesizing means which detects a rotating amount of a first rotary member by a first light detecting means to detect an amount of relative movement between the object and the image reading apparatus and which obtains a whole image of the object on the basis of a partial image obtained by the first light detecting means and the movement amount.-

Please replace the paragraph beginning at page 4, line 22, with the following rewritten paragraph:

C6 - In accordance with another object of the invention, there is provided an image reading apparatus according to the above aspect, wherein a light-dark pattern is formed on a surface at one end of the first rotary member, and wherein the first light detecting means detects light emitted from a first light source and transmitted through the light-dark pattern to thereby detect a rotating amount of the first rotary member.-

Please replace the paragraph beginning at page 5, line 6, with the following rewritten paragraph:

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--In accordance with another aspect of the invention, there is provided an image reading apparatus according to the foregoing aspects, wherein the first light detecting means is at a position where it receives reflected light generated from the interface between the object of reading and the input surface and determined by Snell's law.--

Please replace the paragraph beginning at page 5, line 11, with the following rewritten paragraph:

--In accordance with still another aspect of the invention, there is provided an image reading apparatus according to the foregoing aspects, wherein the first light detecting means is at a position where it receives reflected light generated from the interface between the object of reading and the input surface and determined by Snell's law and scattered light generated from the interface between the input surface of the first rotary member and the object.--

Please replace the paragraph beginning at page 5, line 18 with the following rewritten paragraph:

--In accordance with yet another aspect of the invention, there is provided an image reading apparatus according to the foregoing aspects, wherein incident light

emitted from the first light source and incident on the input surface has a plurality of different incidence angle components.--

Please replace the paragraph beginning at page 5, line 23, with the following rewritten paragraph:

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--In accordance with still yet another aspect of the invention, there is provided an image reading apparatus according to one of the foregoing aspects, wherein there is provided one of an image formation optical system and a mirror between optical paths of the first rotary member and the first light detecting means.--

Please replace the paragraph beginning at page 6, line 4, with the following rewritten paragraph:

--In accordance with another aspect of the invention, there is provided an image reading apparatus according to one of the foregoing aspects, wherein there is provided an optical fiber bundle between the optical paths of the first rotary member and the first light detecting means.--

Please replace the paragraph beginning at page 6, line 9, with the following rewritten paragraph:

--In accordance with another aspect of the invention, there is provided an image reading apparatus according to one of the foregoing aspects, wherein the first

rotary member and the image formation optical system are formed of a glass base material which is an inorganic base material or a synthetic resin which is an organic base material.--

C7 [Please replace the paragraph beginning at page 6, line 14, with the following rewritten paragraph:

--In accordance with a further aspect of the invention, there is provided an image reading apparatus according to one of the foregoing aspects, wherein there is provided on the input surface of the first rotary member a dirt prevention layer adapted to prevent dirt from adhering to the surface.--

[Please replace the paragraph beginning at page 6, line 19, with the following rewritten paragraph:

--In accordance with still a further aspect of the invention, there is provided an image reading apparatus according to one of the foregoing aspects, wherein there is provided a cleaner adapted to remove dirt adhering to the surface of the first rotary member.--

[Please replace the paragraph beginning at page 6, line 23, with the following rewritten paragraph:

--In accordance with still yet a further aspect of the invention, there is provided an image reading apparatus

according to one of the foregoing aspects, wherein the object includes an object having protrusions and recesses like a fingerprint and an object having light and shade like an original document.--

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Please replace the paragraph beginning at page 7, line 4, with the following rewritten paragraph:

--In accordance with a still yet further aspect of the invention, there is provided an image reading apparatus according to one of the foregoing aspects, wherein there is provided a function by which a one-dimensional position input is effected in accordance with the rotating amount of the first rotary member.--

Please replace the paragraph beginning at page 7, line 9, with the following rewritten paragraph:

--In accordance with an additional aspect of the invention, there is provided an image reading apparatus according to one of the foregoing aspects, further comprising a second rotary member having a rotation axis different from the rotation axis of the first rotary member and a means for detecting a rotating amount of the second rotary member, wherein there is provided a function by which a two-dimensional position input is effected in accordance with the rotating amount of the first rotary member and that of the second rotary member.--

**Please replace the paragraph beginning at page 7, line 17,
with the following rewritten paragraph:**

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-+In accordance with another additional aspect of the invention, there is provided an image reading apparatus according to one of the foregoing aspects, further comprising a second rotary member which has a rotation axis different from the rotation axis of the first rotary member and on the surface of one end portion of which a light-dark pattern is formed, a second light source, a second light detecting means, and a rotating amount detecting means for detecting a rotating amount of the second rotary member by detecting light emitted from the second light source and transmitted through the light-dark pattern formed on the surface of the second rotary member, wherein there is provided a function by which a two-dimensional position input is effected in accordance with the rotating amount of the first rotary member and that of the second rotary member.--

Please replace the paragraph beginning at page 8, line 8, with the following rewritten paragraph:

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--Fig. 1 is a sectional view showing main components of an image reading apparatus according to an embodiment of the present invention; Fig. 2 is a sectional view showing main components of an image reading apparatus according to an

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embodiment of the present invention; Fig. 3 is a perspective view showing a rotary member and a light-dark pattern; Fig. 4 is a sectional view illustrating the positional relationship between a light-dark pattern, incident light, and reflected light; Figs. 5A and 5B are diagrams showing the relationship between a light-dark pattern and the output of a light detecting means; Fig. 6 is a sectional view showing the relationship between the refractive index and incidence-angle/reflectance characteristics; Figs. 8A and 8B are section views showing the relationship between incident light, reflected light, and scattered light; Figs. 9A and 9B are sectional views of an image reading apparatus according to an embodiment of the present invention which is capable of reading both a fingerprint and an original; Figs. 10A and 10B are sectional views of an image reading apparatus according to an embodiment of the present invention which is capable of reading both a fingerprint and an original; Figs. 11A and 11B are sectional views of an image reading apparatus according to an embodiment of the present invention which is capable of reading both a fingerprint and an original; Figs. 12A and 12B are sectional views showing an image reading apparatus according to an embodiment of the present invention; Fig. 13 is a sectional view showing an image reading apparatus according to an embodiment of the present invention; Fig. 14 is a sectional view showing an image reading apparatus

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according to an embodiment of the present invention; Fig. 15 is a perspective view showing an image-reading/input apparatus according to an embodiment of the present invention, Figs. 16A and 16B are diagrams showing a mobile phone in which an image-reading/input apparatus according to an embodiment of the present invention is mounted; Fig. 17 is a schematic diagram showing a mouse in which an image-reading/input apparatus according to an embodiment of the present invention is mounted; Fig. 18 is a sectional view showing a conventional image reading apparatus; and Fig. 19 is a sectional view showing a conventional image reading apparatus.

Please replace the paragraph beginning at page 12, line 3, with the following rewritten paragraph:

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—Figs. 5A and 5B show the relationship between the light-dark pattern and the output of the light detecting means. In comparison with the strip-like light-dark pattern shown in Fig. 5A, the triangular light-dark pattern shown in Fig. 5B is more advantageous in that it allows the rotating direction to be detected easily and that it makes it possible to achieve higher resolution for the same cycle of the light-dark pattern. In this way, in the image reading apparatus of the present invention, a partial image is detected and, at the same time, the rotating amount of the rotary member is detected, so that even if the finger movement is not smooth,

it is possible to synthesize a whole image relatively easily. While in the method of detecting the rotating amount of the rotary member shown in Fig. 3 a light-dark pattern is formed at one end of the rotary member and the rotating amount is detected through variation in the amount of light transmitted through the light-dark pattern, the method of detecting the rotating amount of the rotary member in the present invention is not restricted to this method. For example, it is also possible to use a separate rotary member adapted to rotate in synchronism with the rotary member that is into contact with the finger, detecting the rotating amount of the separate rotary member by the light detecting means.--

Please replace the paragraph beginning at page 12, line 24, with the following rewritten paragraph:

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--Next, the basic principle of reading a partial image of a fingerprint and an original by the image reading apparatus of the present invention will be described in detail with reference to Figs. 6 through 8. In the following description, the term "reflected light" means a reflected light which follows Snell's law at the interface of the input surface of the rotary member, and the term "scattered light" means a light which is transmitted through the input member and reflected by the finger skin or the original, or the

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interface of the air and the skin or the interface of the original and the air before returning to the input surface side of the rotary member.

Please replace the paragraph beginning at page 14, line 7, with the following rewritten paragraph:

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Reflectance curve 10 indicates the reflectance when the refractive index of the rotary member is 1.5, and reflectance curve 11 indicates the reflectance when the refractive index of the rotary member is 2, the rotary member being in contact with the air in each case. Reflectance curve 12 indicate the reflectance when the refractive index of the rotary member is 2, with the rotary member being in contact with the skin.

Please replace the paragraph beginning at page 14, line 23, with the following rewritten paragraph:

C11

Figs. 8A and 8A are diagrams showing the condition of the incident light, reflected light, and scattered light when a fingerprint is read and when an original is read. Fig. 8A shows the incident light and reflected light when a fingerprint is read. In this way, when the incident light has an illuminance of a value not lower than a fixed value, with the incidence angle being not larger than the critical angle and not smaller than 20 degrees, the contrast at the input

C11

surface of the reflected light from the troughs and the crests of the fingerprint is higher than when light is incident and reflected vertically.

Please replace the paragraph beginning at page 16, line 12, with the following rewritten paragraph:

C12

Figs. 9A and 9B show an image reading apparatus having two light sources. Figs. 10A and 10B show an image reading apparatus having a planar light source capable of switching the light emission area like an EL. Figs. 11A and 11B show an image reading apparatus having a light detecting means with a large light reception area.

Please replace the paragraph beginning at page 18, line 1, with the following rewritten paragraph:

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In the embodiment shown in Figs. 12A and 12B, there is provided between the first rotary member 3 and the light detecting means 5 an image formation optical system composed of a mirror 17, an optical lens 18, and a field stop 19, whereby it is possible to correct image distortion and to achieve a reduction in the size of the light detecting means and the entire apparatus. While in the image reading apparatus shown in Figs. 12A and 12B an equivalence optical system is used with respect to the axial direction of the rotary member, the present invention is also applicable to an

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image reading apparatus using a reduction optical system with respect to the axial direction of the rotary member. --

Please replace the paragraph beginning at page 20, line 8, with the following rewritten paragraph:

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-- Figs. 16A and 16B show a mobile phone containing an image reading apparatus according to the present invention. An image reading apparatus as shown in Fig. 15 is mounted in the mobile phone, and further a software package needed for the identification of a fingerprint, etc. are mounted, whereby it is possible to realize an apparatus which is compact and inexpensive and provided with a fingerprint identifying function, cursor input function, etc. --

IN THE CLAIMS:

Kindly amend claims 1, 2 and 15-26 as follows:

C15
1. (Amended) An image reading apparatus comprising: a light source; an input member having an input surface on which an object to be read is placed, the input member comprising a transparent rotary member mounted to undergo rotation in accordance with movement of the object while the object is in contact with the input surface; light detecting means comprised of a plurality of photoelectric conversion elements for detecting light scattered or reflected at an

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interface between the object and the input surface; and image synthesizing means for detecting an amount of rotation of the rotary member and producing an image of the object on the basis of partial images obtained by the light detecting means and the amount of rotation of the rotary member.

2. (Amended) An image reading apparatus according to claim 1; wherein a repeating pattern of light and dark portions is formed on a surface at one end of the rotary member; and wherein the light detecting means detects light emitted from the light source and transmitted through the repeating pattern to detect the amount of rotation of the rotary member.

C16
15. (Amended) An image reading apparatus according to claim 1; wherein the light detecting means is disposed at a position where it receives reflected light generated at the interface between the object and the input surface according to Snell's law.

16. (Amended) An image reading apparatus according to claim 1; wherein the light detecting means is disposed at a position where it receives reflected light generated at the interface between the object and the input surface according to Snell's law and scattered light generated at the interface between the input surface of the first rotary member and the object.

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17. (Amended) An image reading apparatus according to claim 2; wherein incident light emitted by the light source and incident on the input surface has a plurality of different incidence angle components.

18. (Amended) An image reading apparatus according to claim 1; further comprising one of an image formation optical system and a mirror disposed between optical paths of the rotary member and the light detecting means.

19. (Amended) An image reading apparatus according to claim 1; further comprising an optical fiber bundle disposed between optical paths of the rotary member and the light detecting means.

20. (Amended) An image reading apparatus according to claim 1; wherein the rotary member is formed of a glass base material, which is an inorganic base material, or a synthetic resin, which is an organic base material.

21. (Amended) An image reading apparatus according to claim 1; further comprising a dirt prevention layer provided on the input surface of the rotary member for preventing dirt from adhering to the input surface.

22. (Amended) An image reading apparatus according to claim 1; further comprising a cleaner provided on a surface of the rotary member for removing dirt adhering to the surface.

(16) 23. (Amended) An image reading apparatus according to claim 1; wherein the object comprises one of an object having protrusions and recesses like a fingerprint or light and dark portions like a document.

24. (Amended) An image reading apparatus according to claim 1; wherein rotation of the rotary member causes one-dimensional position input.

25. (Amended) An image reading apparatus according to claim 1; further comprising a second rotary member mounted to undergo rotation with the rotary member and having a rotation axis different from that of the rotary member; and means for detecting an amount of rotation of the second rotary member so that two-dimensional position input is effected in accordance with an amount of rotation of the rotary member and the second rotary member.

26. (Amended) An image reading apparatus according to claim 2; further comprising a second rotary member mounted to undergo rotation with the rotary member and having a rotation axis different from that of the rotary member; a

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repeating pattern of light and dark portions provided on the surface of one end portion of the second rotary member; a second light source; second light detecting means; and rotating amount detecting means for detecting a rotating amount of the second rotary member by detecting light emitted by the second light source and transmitted through the repeating pattern formed on the surface of the second rotary member to enable two-dimensional position input in accordance with the rotating amount of the first rotary member and that of the second rotary member.

Kindly add the following new claims 27-31:

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27. An image reading apparatus comprising: a housing; an input surface provided in the housing on which an object to be read is passed across; a rotary member mounted in the housing to undergo rotational movement along with linear movement of the object across the input surface; a light source provided in the housing for emitting light toward the object and the rotary member; a light detector provided in the housing for receiving light reflected or scattered by interaction between the object and the rotary member as the object is passed across the input surface; and image generating means for producing an image of the object by synthesizing outputs of the light detector obtained at each of a plurality of angular positions of the rotary member as the object is passed across the input surface.

28. An image reading apparatus according to claim 27; wherein the object is brought into contact with a surface of the rotary member as the object is passed across the input surface.

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29. An image reading apparatus according to claim 27; further comprising rotational amount determining means for determining a rotational amount of the rotary member; wherein the image generating means produces the image of the object based on outputs of the light detector and the rotational amount determining means.

30. An image reading apparatus according to claim 29; wherein the rotational amount determining means comprises a repeating pattern imprinted on the rotary member, and a light detector for detecting light reflected by the repeating pattern.

31. An image reading apparatus according to claim 27; wherein the light detector is mounted in the housing at a position relative to the rotary member such that it receives reflected light produced from an interaction between the object and the rotary member according to Snell's law.